1260803

PATENT SPECIFICATION

(11) 1260803

DRAWINGS ATTACHED

(21) Application No. 13427/70 (22) Filed 19 March 1970

(45) Complete Specification published 19 Jan. 1972

(51) International Classification F 15 b 20/00

(52) Index at acceptance

F1P 2 3X

B8J 1 14

(72) Inventor GORDON ROBERT WINDERS

(54) ANTI-CREEP HYDRAULIC POSITIONING DEVICE

(71) We, DIAMOND POWER SPECIALITY CORPORATION, a Corporation organised and existing under the laws of the State of Ohio, United States of America, of U.S. Route 22 East, Lancaster, Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

THIS INVENTION relates to an anti-creep hydraulic actuating and positioning device.

Hydraulic servo mechanisms for accurately controlling and varying the position of an object from a remote point by means of hydrostatic pressure are subject to the limitation that some leakage of fluid is unavoidable where a piston and cylinder are employed. Such leakage past the piston has made it difficult or impossible to accurately maintain the position of the piston over an extended period of time. The present invention provides means for automatically maintaining the desired positioning of the actuating piston of such a device with great accuracy while nevertheless permitting the piston to be moved under hydraulic pressure when desired to new positions, which will thereafter be similarly accurately maintainable until intentionally changed.

According to the invention there is provided a hydraulic actuating and positioning device comprising a cylinder part and a piston parts, means for delivering fluid to a space in the cylinder on one side of the piston to move the piston against a load, and for trapping fluid in such space substantially to immobilise the piston against return, and means for preventing unwanted return movement of the piston due to leakage of trapped fluid, comprising supplemental make-up fluid delivery means connected to said space and having a fluid delivery capacity in excess of the rate of leakage past the piston, and flow control means responsive to relative movement of the piston and cylinder for variably controlling the effective maintenance of make-up fluid in said space in proportion to leakage past the piston as measured by such relative movement. Preferably the flow control means comprises a valve to vary the rate of flow and actuating means for the valve comprising member having a friction-slip connection to one of said parts and a limited lost-motion connection to the other part, the frictional resistance of the friction-slip connection exceeding the resistance of the valve to operative movement. In one embodiment the flow control means comprises a passage in the piston by passing a seal between the piston and cylinder, the valve being movable to vary the rate of flow through the bypass passage and the member having limited lost motion connection to the piston and a friction-slip connection to the cylinder. In an alternative embodiment the device includes an escape passage from said space with the valve being arranged to vary the flow through said escape passage.

The invention will be described, merely by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a somewhat diagrammatic diametric longitudinal section of a hydraulic actuator embodying the invention;

Figure 2 is a fragmentary detail sectional view taken substantially on the line 2—2 of Figure 1 and looking in the direction of the arrows, and

Figures 3, 4 and 5 are views similar to Figure 1 showing modified forms of the invention.

As shown in Figure 1 a piston 10 is movable in a fixedly supported cylinder 12 to actuate a load (not shown) through the agency of the piston rod 14. A main fluid pressure supply line 15 supplies the fluid which is employed to move the piston upwardly. The piston is gravity-biased downwardly. When it is intended that the piston and load remain station, the supply line 15 is tightly closed by suitable valving means as 35 to trap the fluid in the cylinder space 11 below the

[Price 25p]

piston. The piston is provided with a sealing ring 16, and it will be appreciated that a certain amount of leakage past such ring is unavoidable. A second source of fluid supply is introduced into the cylinder below the piston through line 18 when the piston is stationary, at a rate slightly exceeding the leakage past the sealing ring 16.

The piston is also provided with a valve actuating ring 20 which bears frictionally against the cylinder wall with a force which exceeds the force of gravity on the ring by an amount which exceeds the force required to move a spring-returned valve ball 26 which is operated towards its closed position by the ring in a manner to be described. The ring 20 is capable of substantial axial movement in its ring groove 22, and free axial flow of fluid past the ring is permitted through grooves 23, a plurality of which are formed axially on the peripheral surface of the ring.

The space 24 beyond the piston 10 is either vented to atmosphere or connected to a return line (not shown) to return to a reservoir or other desired destination fluid which gets past the piston. The ring groove 22 is connected to the space 24 via an escape passage 25 in which the piston which bypasses the sealing ring 16, communication between the ring groove 22 and passage 25 being controlled by a servo valve comprising the ball 26 which is biased by a spring 28 toward an open position in which it projects farther into the ring groove 22. The ball and the seat defined by the enlarged ball chamber 30 are so proportioned and located that the valve when fully closed against its seat, still projects somewhat into the chamber defined by the ring groove 22.

When the main fluid delivery positioning line 15 is sealed by valve 35 in order to maintain the piston in a desired position, fluid is delivered to the space 11 below the piston 10 via the servo line 18 at a flow rate which is in excess of the leakage past sealing ring 16. If under such conditions, due to leakage past the seal 16, the piston tends to fall, the ring 20 maintains itself in position and the valve tends to close as the seat moves toward the valve ball 26. Due to such throttling of the servo fluid the piston is maintained against any substantial descent and is held up far enough to maintain a degree of opening of the valve which just compensates for the leakage past the ring 16.

In the modified forms of the invention shown in Figures 3, 4 and 5, many parts will be recognised as analogous in function to those already described and therefore will require no detailed redescription. They are designated by similar reference characters distinguished by addition of the letters "A", "B", or "C" in these respective additional embodiments.

In the embodiment of Figure 3, the frictionally positioned ring 20A is located between the sealing ring 16A and the escape-return chamber 24A and the servo fluid bypass passage 25A extends from the cylinder pressure chamber 11A to the valve chamber 30A located above and opening into the ring groove 22A in similar fashion. The servo fluid excess which passes the valve is conducted to the escape-return chamber 24A via clearance 33 between the periphery of the piston and the cylinder wall. The servo fluid supply line 18A is connected to the positioning line 15A above the control valve 35A.

In the embodiment of Figure 4 in which the piston rod 14B extends downwardly for connection to a suspended load (not shown), the servo valve ball 26B is controlled by a disc 20B which is frictionally fitted to the piston rod 14B, and which because of such friction fit is similarly capable of maintaining itself in position with respect to the rod 14B except when the later is positively moved under hydraulic pressure or by the bias comprising the weight of the load. The axial travel of the disc 20B in its chamber 22B is sufficient to actuate the valve ball 26B between its closed and open positions. The piston 10B is provided with a sealing ring 16B and the piston rod 14B is also sealed with respect to the cylinder 12B by a sealing ring 36.

It will be noted that in this embodiment when the piston 10B tends to fall the downward movement of the disc 20B tends to open the servo valve, which thus admits only enough fluid to compensate for the leakage past the rings 16B, 36. Thus, it is not necessary to provide a continuous flow rate in excess of the leakage. When the positioning line 15B is closed to maintain the piston in position, the fluid admitted via the servo line 18B will merely be sufficient to compensate for the leakages. It is only essential that the line 18B should have a capacity in excess of any expected leakage so that the valve 26B may be opened to an extend necessary to admit sufficient fluid to compensate for such leakage.

The embodiment of Figure 5 is similar to that of Figure 4, but resembles the embodiments of Figures 1—3 in that a constant supply of fluid exceeding the leakage is delivered via the servo line 18C while the positioning line 15C is sealed, to maintain the position of the piston under load, and the excess beyond that required to maintain the piston in position escapes past the open valve ball 26C to the return escape passage 38. In the embodiments of Figures 4 and 5 fluid conducting clearance is provided at 40B and 40C respectively, between the

chamber 22B or 22C and the cylinder space 11B or 11C, and around the disc 20B or 20C.

WHAT WE CLAIM IS:—

1. A hydraulic actuating and positioning device comprising a cylinder part and a piston part, means for delivering fluid to a space in the cylinder on one side of the piston to move the piston against a load, and for trapping fluid in such space substantially to immobilise the piston against return, and means for preventing unwanted return movement of the piston due to leakage of trapped fluid, comprising supplemental make-up fluid delivery means connected to said space and having a fluid delivery capacity in excess of the rate of leakage past the piston, and flow control means responsive to relative movement of the piston and cylinder for variably controlling the effective maintenance and make-up fluid in said space in proportion to leakage past the piston as measured by such relative movement.

2. A device as claimed in claim 1, wherein the flow control means comprises a valve to vary the rate of flow and actuating means for the valve comprising a member having a friction-slip connection to one of said parts and a limited lost motion connection to the other part, the frictional resistance of the friction-slip connection exceeding the resistance of the valve to operative movement.

3. A device as claimed in claim 2, wherein the flow control means comprises a passage in the piston bypassing a seal between the piston and cylinder, the valve being movable to vary the rate of flow through the bypass passage, and the member having limited lost motion connection to the piston and a friction-slip connection to the cylinder.

4. A device as claimed in claim 2, including an escape passage from said space with the valve being arranged to vary the flow through said escape passage.

5. A device as claimed in claim 4, wherein the escape passage and valve are carried by the piston.

6. A device as claimed in claim 5, wherein the member for actuating the valve comprises a piston ring having lost motion connection to the piston and a friction fit in the cylinder.

7. A device as claimed in claim 4, wherein the escape passage and valve are carried by the cylinder.

8. A device as defined in claim 7, wherein the member for actuating the valve has a limited lost motion connection to the cylinder and a frictional-slip connection to a piston.

9. A device as claimed in claim 2, wherein the valve is in said supplemental fluid delivery means.

10. A device as defined in claim 1, wherein the flow control means comprises a valve in the supplemental fluid delivery means.

11. A hydraulic actuating and positioning device constructed and arranged to operate substantially as herein described with reference to and as illustrated in Figures 1 and 2, Figure 3, Figure 4 or Figure 5 of the accompanying drawings.

J. A. KEMP & CO.,
Chartered Patent Agents,
14, South Square,
Gray's Inn,
London, W.C.1.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1972.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1260803 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

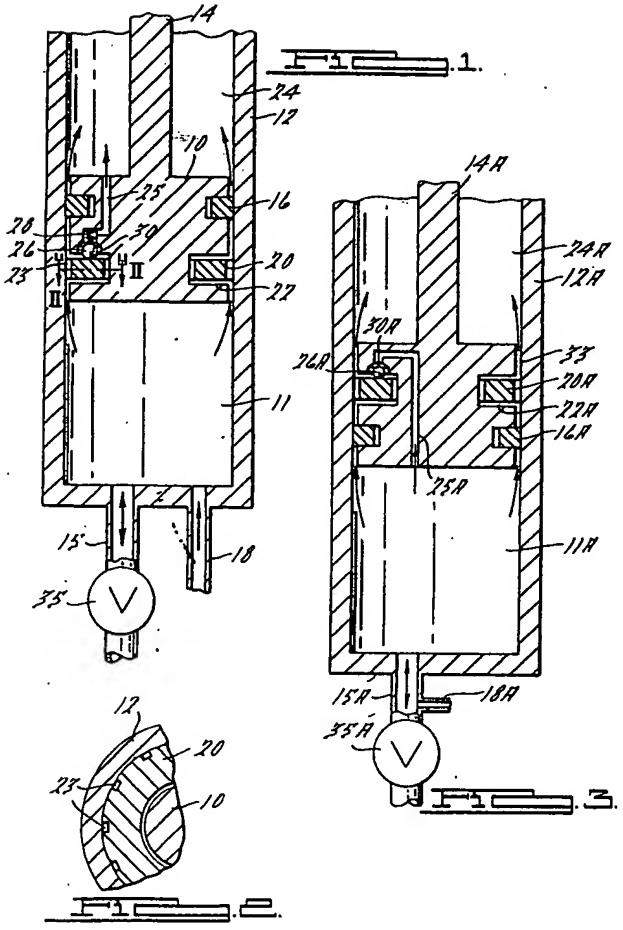

FIG. 1.

FIG. 3.

FIG. 2.

1260803 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

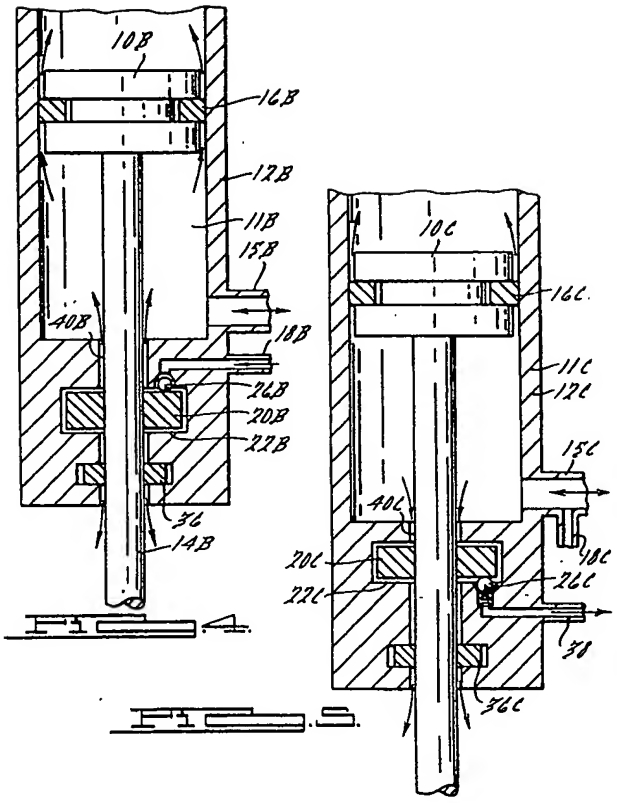

FIG. 4.

FIG. 5.